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(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
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Fischer-tropsch catalyst composition

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FISCHER-TROPSCH CATALYST COMPOSITION

The present invention relates to a catalyst composition suitable for the conversion of carbon monoxide and hydrogen to C_5^+ hydrocabon mixtures, comprising a Fischer-Tropsch catalyst component and an acidic component. The invention further relates to a process for the conversion of carbon monoxide and hydrogen to C_5^+ hydrocabon mixtures using this catalyst.

It is known to convert carbon monoxide and hydrogen to larger hydrocarbons using a composition comprising a Fischer-Tropsch catalyst component and an acidic component.

For instance, US 4,595,702 discloses a Fischer-Tropsch process using a copper-containing iron catalyst as Fischer-Tropsch catalyst component and a zeolite selected from the group of ZSM-5, ZSM-45 and zeolite beta as the acidic component.

US 4,556,645 discloses the combined use of a Fischer-Tropsch catalyst component and a crystalline, microporous silicoaluminophosphate, non-zeolitic molecular sieve as the acidic component.

It has now been found that a fluid catalytic cracking (FCC) catalyst can be suitably used as solid acid component. This is a very favourable type of solid acid component, because it is less expensive than the above-mentioned solid acids. A spent FCC catalyst or an equilibrium catalyst (E-cat) is particularly favourable as it is even less expensive than fresh FCC catalyst.

Hence, the present invention relates to a catalyst composition suitable for the conversion of carbon monoxide and hydrogen to C_5^+ hydrocabon mixtures, comprising

(a) a Fischer-Tropsch catalyst component, and

(b) a FCC catalyst component.

The term 'FCC catalyst' refers to any catalyst composition that can suitably be used in FCC processes. Any conventional FCC catalyst can be used in the process according to the invention. FCC catalysts generally contain zeolite Y, clay (e.g. kaolin, metakaolin, bentonite), silica, alumina, rare-earth metal compounds, etc.

Preferably, a metal compound is deposited on the FCC catalyst. Examples of suitable metals are rare earth metals, e.g. Ce, La, and transition metals of Groups IV-VIII of the Periodic System, e.g. V, Cr, Mn, Fe, Co, Ni, Cu, Zr, Nb, Ru, Re, etc.

This metal compound is preferably present in or on the FCC catalyst in amounts of 0.1 to 10 wt%, more preferably 0.3 to 2 wt%, calculated as oxide, and based on the total weight of metal-containing FCC catalyst.

The metal compound can be deposited on the FCC catalyst in any manner known in the art. Examples of such methods are impregnation, ion-exchange, and deposition precipitation of soluble metal salts.

If desired, the metal-deposited FCC catalyst is calcined after the metal compound has been deposited.

The advantage of using a spent FCC catalyst is that it is less expensive than a fresh FCC catalyst. Furthermore, as the hydrocarbon feed to be cracked in an FCC unit generally contains various metals, e.g. nickel, spent FCC catalyst may already contain the desired metal component, without performing an additional deposition step.

The Fischer-Tropsch catalyst component can be any conventional Fischer-Tropsch catalyst, preferably comprising iron and/or cobalt. For the preparation of such catalysts it is referred to, e.g., WO 01/97968, WO 01/89686/ and WO 01/70394.

The Fischer-Tropsch catalyst component can be promoted with various metals, e.g. Al, Ti, Cr, Mn, Ca, Na and/or K. Furthermore, the Fischer-Tropsch catalyst component can contain binder materials, such as silica and/or alumina.

The FCC catalyst component is present in the catalyst composition according to the invention in an amount of 5 to 40 wt%, more preferably from 10 to 30 wt%, based on the total weight of the catalyst composition.

The catalyst composition can be a physical mixture of Fischer-Tropsch catalyst component particles and FCC catalyst component particles. On the other hand, the catalyst composition can also comprise one type of particle, containing both the Fischer-Tropsch catalyst component and the FCC catalyst component together with a binder.

The invention further relates to a process for the conversion of carbon monoxide and hydrogen to C_5^+ hydrocarbon mixtures, said process comprising contacting carbon monoxide and hydrogen with the above catalyst composition comprising a Fischer-Tropsch catalyst component and a FCC catalyst component.

This process can be carried out in any suitable reactor, such as a (fixed) fluidised bed reactor.

The process is preferably a high-temperature Fischer-Tropsch process. The temperature ranges preferably from 250° to 400°C, more preferably from 300° to 370°C, and most preferably from 330° to 350°C. The pressure preferably ranges from 10 to 60 bar, more preferably 15 to 30 bar, and most preferably about 20 bar.

The H_2/CO volume ratio preferably ranges from 0.2 to 6.0, preferably 0.5-6, most preferably 1-3.

The resulting hydrocarbon product preferably contains, on a mass basis, at least 35%, more preferably at least 45%, and most preferably at least 50% of C_5^+ compounds. The process may be used for the production of aromatics, branched hydrocarbons, and/or olefins. Preferably, the process is used for the production of liquid fuel, especially gasoline and preferably unleaded gasoline.

CLAIMS

1. Catalyst composition suitable for the conversion of carbon monoxide and hydrogen to C_5^+ hydrocabon mixtures, comprising
   (a) a Fischer-Tropsch catalyst componenet, and
   (b) a fluid catalytic cracking catalyst component.

2. Catalyst composition according to claim 1 wherein the Fischer-Tropsch catalyst component comprises iron.

3. Catalyst composition according to claim 1 wherein the Fischer-Tropsch catalyst component comprises cobalt.

4. Catalyst composition according to any one of the preceding claims wherein the fluid catalytic cracking catalyst component is a spent fluid catalytic cracking catalyst.

5. Catalyst composition according to any one of the preceding claims wherein the fluid catalytic cracking component is a fluid catalytic cracking catalyst with a metal compound deposited thereon.

6. Catalyst composition according to claim 5 wherein the metal compound comprises a metal selected from the group consisting of Group IV metals, Group V metals, Group VI metals, Group VII metals, Group VIII transition metals, rare earth metals, and combinations thereof.

7. Catalyst composition according to any one of the preceding claims wherein the fluid catalytic cracking catalyst component is present in the catalyst composition in an amount of 5 to 40 wt% based on the total weight of the catalyst composition.

8. Process for the conversion of carbon monoxide and hydrogen to C_5^+ hydrocabon mixtures, said process comprising contacting carbon monoxide and hydrogen with a catalyst composition according to any of the claims 1-7.

Abstract

The present invention relates to a catalyst composition suitable for the conversion of carbon monoxide and hydrogen to C_5^+ hydrocabon mixtures. This catalyst composition comprises a Fischer-Tropsch catalyst component, and a fluid catalytic cracking (FCC) catalyst component.

Preferably, the fluid catalytic cracking catalyst is a spent FCC catalyst or an equilibrium catalyst.